

CLAIMS

What is claimed is:

1. An apparatus for analyzing at least one
5 individual gas component in a multi-component gas
mixture, comprising:
- (a) an array of at least two chemo/electro-
active materials connected in parallel
circuitry, each chemo/electro-active
10 material exhibiting a different electrical
response characteristic upon exposure to
the individual gas component than each
other chemo/electro-active material;
 - (b) means for determining an electrical
15 response of each chemo/electro-active
material upon exposure of the array to the
gas mixture;
 - (c) means for determining a value for the
temperature of the array connected in
20 parallel circuitry with the chemo/elctro-
active materials; and
 - (d) means for digitizing the electrical
responses and the temperature value, and
calculating a value from the digitized
25 electrical responses and temperature
value, to perform an analysis of the
individual gas component.
2. An apparatus according to Claim 1 wherein the
array is situated within the gas mixture, which has a
30 temperature of about 400°C or more.
3. An apparatus according to Claim 1 wherein the
gas mixture is an emission from a combustion process.
4. An apparatus according to Claim 1 wherein the
component gases in the gas mixture are not separated.
- 35 5. An apparatus according to Claim 1 wherein the
temperature of each chemo/electro-active material is
determined substantially only by the variable
temperature of the gas mixture.

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6. An apparatus according to Claim 1 wherein the analysis is performed from the electrical responses of the chemo/electro-active materials upon exposure to the multi-component gas mixture only.

5 7. An apparatus according to Claim 1 wherein the means for performing analysis is means for calculating the concentration within the gas mixture of the individual gas component.

8. An apparatus according to Claim 1 wherein at
10 least one chemo/electro-active material, when at a temperature of about 400°C or more, (i) has an electrical resistivity in the range of about 1 ohm-cm to about 10^5 ohm-cm, and (ii) exhibits a change in electrical resistance of at least about 0.1 percent
15 upon exposure of the material to an individual gas component, as compared to the resistance before exposure.

9. An apparatus according to Claim 1 wherein the electrical response characteristic of each material
20 upon exposure to the gas mixture at a selected temperature is quantifiable as a value, and the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an individual gas component
25 at the selected temperature for a period of at least about one minute.

10. An apparatus according to Claim 1 wherein the electrical response is selected from the group consisting of resistance, impedance, capacitance,
30 voltage or current.

11. An apparatus according to Claim 1 wherein at least one chemo/electro-active material is a metal oxide.

12. In a multi-component gas mixture having a
35 temperature of about 400°C or more, an apparatus for calculating the concentration of at least two individual analyte gas components in the mixture, comprising:

- 5 (a) an array of at least three chemo/electro-active materials, the array being situated within the gas mixture, and each chemo/electro-active material having a different electrical response characteristic upon exposure to each of the individual analyte gas components than each of the other chemo/electro-active materials;
- 10 (b) means for determining an electrical response of each chemo/electro-active material upon exposure of the array to the unseparated components of the gas mixture; and
- 15 (c) means for calculating the concentration of each of the individual analyte gas components from the electrical responses of the chemo/electro-active materials upon exposure to the multi-component gas mixture only.
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13. An apparatus according to Claim 12 wherein the gas mixture is an emission from a combustion process.

14. An apparatus according to Claim 12 wherein the temperature of each chemo/electro-active material is
 25 determined substantially only by the variable temperature of the gas mixture.

15. An apparatus according to Claim 12 wherein at least one chemo/electro-active material, when at a temperature of about 400°C or more, (i) has an
 30 electrical resistivity in the range of about 1 ohm-cm to about 10^5 ohm-cm, and (ii) exhibits a change in electrical resistance of at least about 0.1 percent upon exposure of the material to an analyte gas component, as compared to the resistance before
 35 exposure

16. An apparatus according to Claim 12 wherein the electrical response characteristic of each material upon exposure to the gas mixture at a selected

temperature is quantifiable as a value, and the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an analyte gas component at the selected temperature for a period of at least about one minute.

17. An apparatus according to Claim 12 wherein the electrical response is selected from the group consisting of resistance, impedance, capacitance, voltage or current.

18. An apparatus according to Claim 12 wherein at least one chemo/electro-active material is a metal oxide.

19. In a multi-component gas mixture having a temperature of about 400°C or more, an apparatus for calculating the concentration of at least two individual analyte gas components in the mixture, comprising:

- (a) an array of at least three chemo/electro-active materials connected in parallel circuitry, the array being situated within the gas mixture, and each chemo/electro-active material exhibiting a change in electrical resistance upon exposure to each of the individual analyte gas components, wherein at least one chemo/electro-active material, when at a temperature of about 400°C or more, (i) has an electrical resistivity in the range of about 1 ohm-cm to about 10^5 ohm-cm, and (ii) exhibits a change in electrical resistance of at least about 0.1 percent upon exposure of the material to an analyte gas component, as compared to the resistance before exposure;
- (b) means for determining the change in resistance of each chemo/electro-active

material upon exposure of the array to the gas mixture; and

- (c) means for calculating the concentration of each of the individual analyte gas components from the changes in resistance of the chemo/electro-active materials.

20. An apparatus according to Claim 19 wherein the gas mixture is an emission from a combustion process.

21. An apparatus according to Claim 19 wherein the temperature of each chemo/electro-active material is determined substantially only by the variable temperature of the gas mixture.

22. An apparatus according to Claim 19 wherein the electrical response characteristic of each material upon exposure to the gas mixture at a selected temperature is quantifiable as a value, and the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an analyte gas component at the selected temperature for a period of at least about one minute.

23. An apparatus according to Claim 19 wherein at least one chemo/electro-active material is a metal oxide.

24. An apparatus for analyzing at least one individual gas component in a multi-component gas mixture, comprising:

- (a) an array of at least two chemo/electro-active materials, each chemo/electro-active material having a different electrical response characteristic upon exposure at a selected temperature to the individual gas component than each of the other chemo/electro-active materials, the electrical response characteristic of each material being quantifiable as a value, wherein the response value of at least one material is constant or varies by no more

than about twenty percent during exposure of the material to an individual gas component at the selected temperature for a period of at least about one minute;

- 5 (b) means for determining the electrical response value of each chemo/electro-active material upon exposure of the array to the gas mixture; and
- (c) means for performing an analysis of the individual gas component from the electrical response values.

25. An apparatus according to Claim 24 wherein the array is situated within the gas mixture, which has a temperature of about 400°C or more.

- 15 26. An apparatus according to Claim 24 wherein the gas mixture is an emission from a combustion process.

- 27. An apparatus according to Claim 24 wherein the means for performing analysis is means for calculating the concentration within the gas mixture of the individual gas component.

28. An apparatus according to Claim 24 wherein the temperature of each chemo/electro-active material is determined substantially only by the variable temperature of the gas mixture.

- 25 29. An apparatus according to Claim 24 wherein the electrical response is selected from the group consisting of resistance, impedance, capacitance, voltage or current.

- 30 30. An apparatus according to Claim 24 wherein at least one chemo/electro-active material is a metal oxide.

- 31. In a multi-component gas mixture having a temperature of less than about 400°C, an apparatus for analyzing at least one individual gas component in the mixture, comprising:

- (a) an array of at least two chemo/electro-active materials, each chemo/electro-active material having a different

electrical response characteristic upon exposure at a selected temperature to the individual gas component than each of the other chemo/electro-active materials, the array being situated within the gas mixture, and having a substantially constant temperature of about 400C or more;

(b) means for determining the electrical response value of each chemo/electro-active material upon exposure of the array to the gas mixture; and

(c) means for performing an analysis of the individual gas component from the electrical response values.

32. An apparatus according to Claim 31 wherein the component gases in the gas mixture are not separated.

33. An apparatus according to Claim 31 wherein the analysis is performed from the electrical responses of the chemo/electro-active materials upon exposure to the multi-component gas mixture only.

34. An apparatus according to Claim 31 wherein the means for performing analysis is means for calculating the concentration within the gas mixture of the individual gas component.

35. An apparatus according to Claim 31 further comprising means for determining a value for the temperature of the gas mixture connected in parallel circuitry with the chemo/elctro-active materials, and wherein the individual gas component is analyzed from digitized electrical responses and a digitized temperature value.

36. An apparatus according to Claim 31 wherein at least one chemo/electro-active material, when at a temperature of about 400°C or more, (i) has an electrical resistivity in the range of about 1 ohm-cm to about 10^5 ohm-cm, and (ii) exhibits a change in electrical resistance of at least about 0.1 percent

upon exposure of the material to an individual gas component, as compared to the resistance before exposure.

37. An apparatus according to Claim 31 wherein the electrical response characteristic of each material upon exposure to the gas mixture at a selected temperature is quantifiable as a value, and the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an individual gas component at the selected temperature for a period of at least about one minute.

38. An apparatus according to Claim 31 wherein the electrical response is selected from the group consisting of resistance, impedance, capacitance, voltage or current.

39. An apparatus according to Claim 31 wherein at least one chemo/electro-active material is a metal oxide.

40. An apparatus for analyzing at least one individual gas component in a multi-component gas mixture, comprising:

- (a) an array of first and second chemo/electro-active materials, each chemo/electro-active material having a different electrical response characteristic upon exposure at a selected temperature to the individual gas component than each of the other chemo/electro-active materials, wherein the chemo/electro-active materials are selected from the pairings in the group consisting of
 - (i) the first material is M^1O_x , and the second material is $M^1_a M^2_b O_x$;
 - (ii) the first material is M^1O_x , and the second material is $M^1_a M^2_b M^3_c O_x$;

- (iii) the first material is $M^1_a M^2_b O_x$, and the second material is $M^1_a M^2_b M^3_c O_x$;
- (iv) the first material is a first $M^1 O_x$, and the second material is a second $M^1 O_x$;
- 5 (v) the first material is a first $M^1_a M^2_b O_x$, and the second material is a second $M^1_a M^2_b O_x$; and
- (vi) the first material is a first $M^1_a M^2_b M^3_c O_x$, and the second material is a
- 10 second $M^1_a M^2_b M^3_c O_x$;

wherein M^1 is selected from the group consisting of Ce, Co, Cu, Fe, Ga, Nb, Ni, Pr, Ru, Sn, Ti, Tm, W, Yb, Zn, and Zr; M^2 and M^3 are each independently selected from the group consisting of Al, Ba, Bi, Ca, Cd, Ce, Co, Cr,

15 Cu, Fe, Ga, Ge, In, K, La, Mg, Mn, Mo, Na, Nb, Ni, Pb, Pr, Rb, Ru, Sb, Sc, Si, Sn, Sr, Ta, Ti, Tm, V, W, Y, Yb, Zn, and Zr, but M^2 and M^3 are not the same in $M^1_a M^2_b M^3_c O_x$; a, b and c are each independently about 0.0005 to about 1, provided that $a+b+c = 1$; and x is a

20 number sufficient so that the oxygen present balances the charges of the other elements in the compound;

- (b) means for determining the electrical response of each chemo/electro-active material upon exposure of the array to the
- 25 gas mixture; and
- (c) means for performing an analysis of the individual gas component from the electrical responses.

41. An apparatus according to Claim 40 wherein

- 30 (a) $M^1 O_x$ is selected from the group consisting of $Ce_a O_x$, $Co O_x$, $Cu O_x$, $Fe O_x$, $Ga O_x$, $Nb O_x$, $Ni O_x$, $Pr O_x$, $Ru O_x$, $Sn O_x$, $Ta_a O_x$, $Ti O_x$, $Tm O_x$, WO_x , $Yb O_x$, $Zn O_x$, $Zr O_x$, $Sn O_x$ with Ag additive, $Zn O_x$ with Ag additive, $Ti O_x$ with
- 35 Pt additive, $Zn O_x$ with frit additive, $Ni O_x$ with frit additive, $Sn O_x$ with frit additive, or WO_x with frit additive;

- (b) $M^1_a M^2_b O_x$ is selected from the group consisting of $Al_a Cr_b O_x$, $Al_a Fe_b O_x$, $Al_a Mg_b O_x$, $Al_a Ni_b O_x$, $Al_a Ti_b O_x$, $Al_a V_b O_x$, $Ba_a Cu_b O_x$, $Ba_a Sn_b O_x$, $Ba_a Zn_b O_x$, $Bi_a Ru_b O_x$, $Bi_a Sn_b O_x$, $Bi_a Zn_b O_x$, $Ca_a Sn_b O_x$, $Ca_a Zn_b O_x$, $Cd_a Sn_b O_x$, $Cd_a Zn_b O_x$, $Ce_a Fe_b O_x$, $Ce_a Nb_b O_x$, $Ce_a Ti_b O_x$, $Ce_a V_b O_x$, $Co_a Cu_b O_x$, $Co_a Ge_b O_x$, $Co_a La_b O_x$, $Co_a Mg_b O_x$, $Co_a Nb_b O_x$, $Co_a Pb_b O_x$, $Co_a Sn_b O_x$, $Co_a V_b O_x$, $Co_a W_b O_x$, $Co_a Zn_b O_x$, $Cr_a Cu_b O_x$, $Cr_a La_b O_x$, $Cr_a Mn_b O_x$, $Cr_a Ni_b O_x$, $Cr_a Si_b O_x$, $Cr_a Ti_b O_x$, $Cr_a Y_b O_x$, $Cr_a Zn_b O_x$, $Cu_a Fe_b O_x$, $Cu_a Ga_b O_x$, $Cu_a La_b O_x$, $Cu_a Nb_b O_x$, $Cu_a Ni_b O_x$, $Cu_a Pb_b O_x$, $Cu_a Sn_b O_x$, $Cu_a Sr_b O_x$, $Cu_a Ti_b O_x$, $Cu_a Zn_b O_x$, $Cu_a Zr_b O_x$, $Fe_a Ga_b O_x$, $Fe_a La_b O_x$, $Fe_a Mo_b O_x$, $Fe_a Nb_b O_x$, $Fe_a Ni_b O_x$, $Fe_a Sn_b O_x$, $Fe_a Ti_b O_x$, $Fe_a W_b O_x$, $Fe_a Zn_b O_x$, $Fe_a Zr_b O_x$, $Ga_a La_b O_x$, $Ga_a Sn_b O_x$, $Ge_a Nb_b O_x$, $Ge_a Ti_b O_x$, $In_a Sn_b O_x$, $K_a Nb_b O_x$, $Mn_a Nb_b O_x$, $Mn_a Sn_b O_x$, $Mn_a Ti_b O_x$, $Mn_a Y_b O_x$, $Mn_a Zn_b O_x$, $Mo_a Pb_b O_x$, $Mo_a Rb_b O_x$, $Mo_a Sn_b O_x$, $Mo_a Ti_b O_x$, $Mo_a Zn_b O_x$, $Nb_a Ni_b O_x$, $Nb_a Nb_b O_x$, $Nb_a Sr_b O_x$, $Nb_a Ti_b O_x$, $Nb_a W_b O_x$, $Nb_a Zr_b O_x$, $Ni_a Si_b O_x$, $Ni_a Sn_b O_x$, $Ni_a Y_b O_x$, $Ni_a Zn_b O_x$, $Ni_a Zr_b O_x$, $Pb_a Sn_b O_x$, $Pb_a Zn_b O_x$, $Rb_a W_b O_x$, $Ru_a Sn_b O_x$, $Ru_a W_b O_x$, $Ru_a Zn_b O_x$, $Sb_a Sn_b O_x$, $Sb_a Zn_b O_x$, $Sc_a Zr_b O_x$, $Si_a Sn_b O_x$, $Si_a Ti_b O_x$, $Si_a W_b O_x$, $Si_a Zn_b O_x$, $Sn_a Ta_b O_x$, $Sn_a Ti_b O_x$, $Sn_a W_b O_x$, $Sn_a Zn_b O_x$, $Sn_a Zr_b O_x$, $Sr_a Ti_b O_x$, $Ta_a Ti_b O_x$, $Ta_a Zn_b O_x$, $Ta_a Zr_b O_x$, $Ti_a V_b O_x$, $Ti_a W_b O_x$, $Ti_a Zn_b O_x$, $Ti_a Zr_b O_x$, $V_a Zn_b O_x$, $V_a Zr_b O_x$, $W_a Zn_b O_x$, $W_a Zr_b O_x$, $Y_a Zr_b O_x$, $Zn_a Zr_b O_x$, $Al_a Ni_b O_x$ with frit additive, $Cr_a Ti_b O_x$ with frit additive, $Fe_a Ni_b O_x$ with frit additive, $Fe_a Ti_b O_x$ with frit additive, $Nb_a Ti_b O_x$ with frit additive, $Nb_a W_b O_x$ with frit additive, $Ni_a Zn_b O_x$ with frit additive, $Ni_a Zr_b O_x$ with frit additive, or $Ta_a Ti_b O_x$ with frit additive; and/or
- (c) $M^1_a M^2_b M^3_c O_x$ is selected from the group consisting of $Al_a Mg_b Zn_c O_x$, $Al_a Si_b V_c O_x$, $Ba_a Cu_b Ti_c O_x$, $Ca_a Ce_b Zr_c O_x$, $Co_a Ni_b Ti_c O_x$,

$\text{Co}_a\text{Ni}_b\text{Zr}_c\text{O}_x$, $\text{Co}_a\text{Pb}_b\text{Sn}_c\text{O}_x$, $\text{Co}_a\text{Pb}_b\text{Zn}_c\text{O}_x$,
 $\text{Cr}_a\text{Sr}_b\text{Ti}_c\text{O}_x$, $\text{Cu}_a\text{Fe}_b\text{Mn}_c\text{O}_x$, $\text{Cu}_a\text{La}_b\text{Sr}_c\text{O}_x$,
 $\text{Fe}_a\text{Nb}_b\text{Ti}_c\text{O}_x$, $\text{Fe}_a\text{Pb}_b\text{Zn}_c\text{O}_x$, $\text{Fe}_a\text{Sr}_b\text{Ti}_c\text{O}_x$,
 $\text{Fe}_a\text{Ta}_b\text{Ti}_c\text{O}_x$, $\text{Fe}_a\text{W}_b\text{Zr}_c\text{O}_x$, $\text{Ga}_a\text{Ti}_b\text{Zn}_c\text{O}_x$,
 $\text{La}_a\text{Mn}_b\text{Na}_c\text{O}_x$, $\text{La}_a\text{Mn}_b\text{Sr}_c\text{O}_x$, $\text{Mn}_a\text{Sr}_b\text{Ti}_c\text{O}_x$,
 $\text{Mo}_a\text{Pb}_b\text{Zn}_c\text{O}_x$, $\text{Nb}_a\text{Sr}_b\text{Ti}_c\text{O}_x$, $\text{Nb}_a\text{Sr}_b\text{W}_c\text{O}_x$,
 $\text{Nb}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, $\text{Ni}_a\text{Sr}_b\text{Ti}_c\text{O}_x$, $\text{Sn}_a\text{W}_b\text{Zn}_c\text{O}_x$,
 $\text{Sr}_a\text{Ti}_b\text{V}_c\text{O}_x$, $\text{Sr}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, or $\text{Ti}_a\text{W}_b\text{Zr}_c\text{O}_x$.

42. An apparatus according to Claim 40 wherein the
 array is situated within the gas mixture, which has a
 temperature of about 400°C or more.

43. An apparatus according to Claim 40 wherein the
 gas mixture is an emission from a combustion process.

44. An apparatus according to Claim 40 wherein the
 component gases in the gas mixture are not separated.

45. An apparatus according to Claim 40 wherein the
 analysis is performed from the electrical responses of
 the chemo/electro-active materials upon exposure to the
 multi-component gas mixture only.

46. An apparatus according to Claim 40 wherein the
 means for performing analysis is means for calculating
 the concentration within the gas mixture of the
 individual gas component.

47. An apparatus according to Claim 40 further
 comprising means for determining a value for the
 temperature of the gas mixture connected in parallel
 circuitry with the chemo/elctro-active materials, and
 wherein the individual gas component is analyzed from
 digitized electrical responses and a digitized
 temperature value.

48. An apparatus according to Claim 40 wherein the
 temperature of each chemo/electro-active material is
 determined substantially only by the variable
 temperature of the gas mixture.

49. An apparatus according to Claim 40 wherein at
 least one chemo/electro-active material, when at a
 temperature of about 400°C or more, (i) has an
 electrical resistivity in the range of about 1 ohm-cm

to about 10^5 ohm-cm, and (ii) exhibits a change in electrical resistance of at least about 0.1 percent upon exposure of the material to an individual gas component, as compared to the resistance before exposure.

50. An apparatus according to Claim 40 wherein the electrical response characteristic of each material upon exposure to the gas mixture at a selected temperature is quantifiable as a value, and the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an individual gas component at the selected temperature for a period of at least about one minute.

51. An apparatus according to Claim 40 wherein the electrical response is selected from the group consisting of resistance, impedance, capacitance, voltage or current.

52. An apparatus for analyzing at least one individual gas component in a multi-component gas mixture, comprising:

(a) an array of at least two chemo/electro-active materials connected in parallel circuitry, each chemo/electro-active material having a different electrical response characteristic upon exposure at a selected temperature to the individual gas component than each of the other chemo/electro-active materials, the electrical response characteristic of each material being quantifiable as a value, wherein the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an individual gas component at the selected temperature for a period of at least about one minute;

- (b) means for determining the electrical response value of each chemo/electro-active material upon exposure of the array to the gas mixture;
- 5 (c) means for determining a value for the temperature of the gas mixture connected in parallel with the chemo/elctro-active materials; and
- 10 (d) means for digitizing the electrical responses and the temperature value, and calculating a value from the digitized electrical response and temperature value, to perform an analysis of the individual gas component.

15 53. An apparatus according to Claim 52 wherein the array is situated within the gas mixture, which has a temperature of about 400°C or more.

54. An apparatus according to Claim 52 wherein the gas mixture is an emission from a combustion process.

20 55. An apparatus according to Claim 52 wherein the component gases in the gas mixture are not separated.

56. An apparatus according to Claim 52 wherein the temperature of each chemo/electro-active material is determined substantially only by the variable
25 temperature of the gas mixture.

57. An apparatus according to Claim 52 wherein the analysis is performed from the electrical responses of the chemo/electro-active materials upon exposure to the multi-component gas mixture only.

30 58. An apparatus according to Claim 52 wherein the means for performing analysis is means for calculating the concentration within the gas mixture of the individual gas component.

59. An apparatus according to Claim 52 wherein at
35 least one chemo/electro-active material, when at a temperature of about 400°C or more, (i) has an electrical resistivity in the range of about 1 ohm-cm to about 10^5 ohm-cm, and (ii) exhibits a change in

electrical resistance of at least about 0.1 percent upon exposure of the material to an individual gas component, as compared to the resistance before exposure.

5 60. An apparatus according to Claim 52 wherein the electrical response is selected from the group consisting of resistance, impedance, capacitance, voltage or current.

10 61. An apparatus according to Claim 52 wherein the array is situated within the gas mixture, which has a temperature of less than about 400°C, and the array has a substantially constant temperature of about 400°C or more.

15 62. An apparatus according to Claim 52 wherein at least one chemo/electro-active material is a metal oxide.

20 63. In a multi-component gas mixture having a temperature of about 400°C or more, an apparatus for calculating the concentration of at least two individual analyte gas components in the mixture, comprising:

25 (a) an array of at least three chemo/electro-active materials connected in parallel circuitry, the array being situated within the gas mixture, and each chemo/electro-active material exhibiting a change in electrical resistance upon exposure to each of the individual analyte gas components, wherein at least one
30 chemo/electro-active material, when at a temperature of about 400C or more, (i) has an electrical resistivity in the range of about 1 ohm-cm to about 10^5 ohm-cm, and (ii) exhibits a change in electrical
35 resistance of at least about 0.1 percent upon exposure of the material to an analyte gas component, as compared to the resistance before exposure;

(b) means for determining the change in resistance of each chemo/electro-active material upon exposure of the array to the unseparated components of the gas mixture;
5 and

(c) means for calculating the concentration of each of the individual analyte gas components from the changes in resistance of the chemo/electro-active materials upon exposure to the multi-component gas mixture only.
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64. An apparatus according to Claim 63 wherein the gas mixture is an emission from a combustion process.

65. An apparatus according to Claim 63 further comprising means for determining a value for the temperature of the gas mixture connected in parallel circuitry with the chemo/elctro-active materials, and wherein the individual gas component is analyzed from digitized electrical responses and a digitized temperature value.
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66. An apparatus according to Claim 63 wherein the temperature of each chemo/electro-active material is determined substantially only by the variable temperature of the gas mixture.

67. An apparatus according to Claim 63 wherein the electrical response characteristic of each material upon exposure to the gas mixture at a selected temperature is quantifiable as a value, and the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an analyte gas component at the selected temperature for a period of at least about one minute.
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68. An apparatus according to Claim 63 wherein at least one chemo/electro-active material is a metal oxide.
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69. A method for analyzing at least one individual gas component in a multi-component gas mixture, comprising:

- 5 (a) providing an array of at least two chemo/electro-active materials connected in parallel circuitry, each chemo/electro-active material exhibiting a different electrical response characteristic upon exposure to the individual gas component
- 10 than each other chemo/electro-active material;
- (b) exposing the array to the gas mixture ;
- (c) determining an electrical response of each chemo/electro-active material upon
- 15 exposure of the array to the gas mixture;
- (d) determining a value for the temperature of the gas mixture independently of the determination of the electrical responses of the chemo/elctro-active materials; and
- 20 (e) digitizing the electrical responses and the temperature value, and calculating a value from the digitized electrical responses and temperature value to perform an analysis of the individual gas
- 25 component.

70. A method according to Claim 69 wherein the array is situated within the gas mixture, which has a temperature of about 400°C or more.

71. A method according to Claim 69 wherein the gas

30 mixture is an emission from a combustion process.

72. A method according to Claim 69 wherein the component gases in the gas mixture are not separated.

73. A method according to Claim 69 wherein the temperature of each chemo/electro-active material is

35 determined substantially only by the variable temperature of the gas mixture.

74. A method according to Claim 69 wherein the analysis is performed from the electrical responses of

the chemo/electro-active materials upon exposure to the multi-component gas mixture only.

75. A method according to Claim 69 wherein the analysis performed comprises calculating the concentration within the gas mixture of the individual gas component.

76. A method according to Claim 69 wherein at least one chemo/electro-active material, when at a temperature of about 400°C or more, (i) has an electrical resistivity in the range of about 1 ohm-cm to about 10⁵ ohm-cm, and (ii) exhibits a change in electrical resistance of at least about 0.1 percent upon exposure of the material to an individual gas component, as compared to the resistance before exposure.

77. A method according to Claim 69 wherein the electrical response characteristic of each material upon exposure to the gas mixture at a selected temperature is quantifiable as a value, and the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an individual gas component at the selected temperature for a period of at least about one minute.

78. A method according to Claim 69 wherein the electrical response is selected from the group consisting of resistance, impedance, capacitance, voltage or current.

79. A method according to Claim 69 wherein the array is situated in the gas mixture, which has a temperature of less than about 400°C, and the array has a substantially constant temperature of about 400C or more.

80. A method according to Claim 69 wherein at least one chemo/electro-active material is a metal oxide.

81. A method for calculating the concentration of at least two individual analyte gas components in a

multi-component gas mixture having a temperature of about 400°C or more, comprising:

- 5 (a) providing within the gas mixture an array of at least three chemo/electro-active materials, each chemo/electro-active material having a different electrical response characteristic upon exposure to each of the individual analyte gas components than each of the other
- 10 chemo/electro-active materials, wherein at least one chemo/electro-active material, when at a temperature of about 400°C or more, (i) has an electrical resistivity in the range of about 1 ohm-cm to about 10⁵
- 15 ohm-cm, and (ii) exhibits a change in electrical resistance of at least about 0.1 percent upon exposure of the material to an analyte gas component, as compared to the resistance before exposure;
- 20 (b) determining an electrical response of each chemo/electro-active material upon exposure of the array to the unseparated components of the gas mixture; and
- 25 (c) calculating the concentration of each of the individual analyte gas components from the electrical responses of the chemo/electro-active materials upon exposure to the multi-component gas mixture only.

30 82. A method according to Claim 81 wherein the gas mixture is an emission from a combustion process.

83. A method according to Claim 81 wherein the temperature of each chemo/electro-active material is determined substantially only by the variable

35 temperature of the gas mixture.

84. A method according to Claim 81 wherein the electrical response characteristic of each material upon exposure to the gas mixture at a selected

temperature is quantifiable as a value, and the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an analyte gas component at the selected temperature for a period of at least about one minute.

85. A method according to Claim 81 wherein the electrical response is selected from the group consisting of resistance, impedance, capacitance, voltage or current.

86. A method according to Claim 81 wherein at least one chemo/electro-active material is a metal oxide.

87. A method for analyzing at least one individual gas component in a multi-component gas mixture, comprising:

- (a) providing an array of at least two chemo/electro-active materials, each chemo/electro-active material having a different electrical response characteristic upon exposure at a selected temperature to the individual gas component than each of the other chemo/electro-active materials, the electrical response characteristic of each material being quantifiable as a value, wherein the response value of at least one material is constant or varies by no more than about twenty percent during exposure of the material to an individual gas component at the selected temperature for a period of at least about one minute;
- (b) determining the electrical response value of each chemo/electro-active material upon exposure of the array to the gas mixture; and
- (c) performing an analysis of the individual gas component from the electrical response values.

88. A method according to Claim 87 wherein the array is situated within the gas mixture, which has a temperature of about 400°C or more.

89. A method according to Claim 87 wherein the gas
5 mixture is an emission from a combustion process.

90. A method according to Claim 87 wherein the analysis performed comprises calculating the concentration within the gas mixture of the individual gas component.

10 91. A method according to Claim 87 wherein the temperature of each chemo/electro-active material is determined substantially only by the variable temperature of the gas mixture.

15 92. A method according to Claim 87 wherein the electrical response is selected from the group consisting of resistance, impedance, capacitance, voltage or current.

93. A method according to Claim 87 wherein at least one chemo/electro-active material is a metal oxide.

20 94. A method according to Claim 87 wherein the array is situated in the gas mixture, which has a temperature of less than about 400°C, and the array has a substantially constant temperature of about 400°C or more.

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